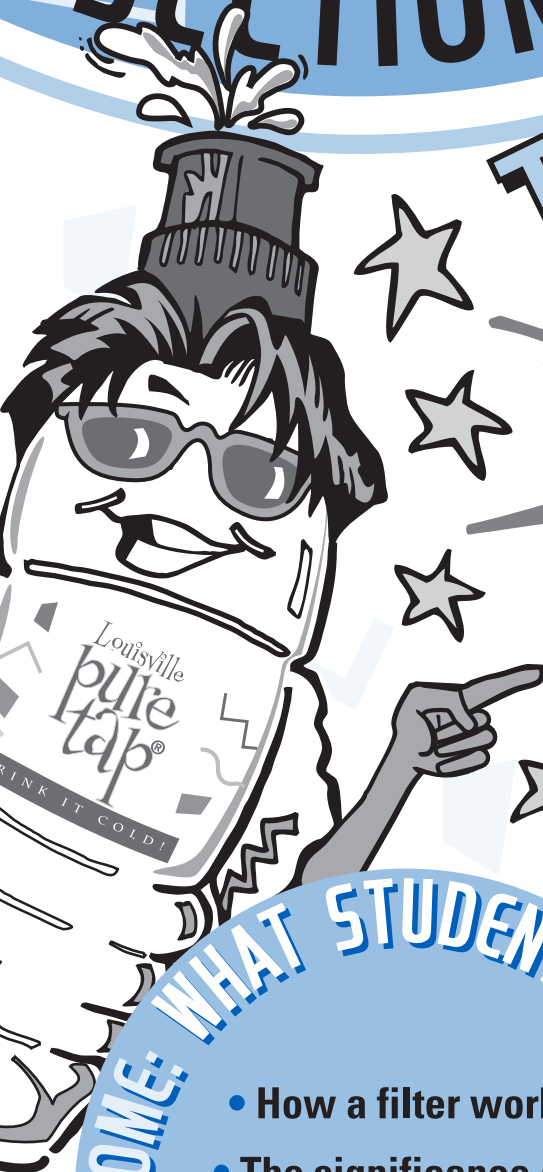


# SECTION 7

# THE FABULOUS FILTER



OUTCOME: WHAT STUDENTS WILL LEARN

- How a filter works.
- The significance of a filter to water treatment.

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pure  
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# CORE CONTENT STANDARDS

## Science

- SC-E-1.1.1 Objects have many observable properties such as size, mass, shape, color, temperature, magnetism and the ability to react with other substances.
- SC-E-2.1.2 Earth materials provide many of the resources humans use. The varied materials have different physical and chemical properties, which make them useful in different ways.
- SC-M-1.1.1 A substance has characteristic physical properties that are independent of the amount of the sample.

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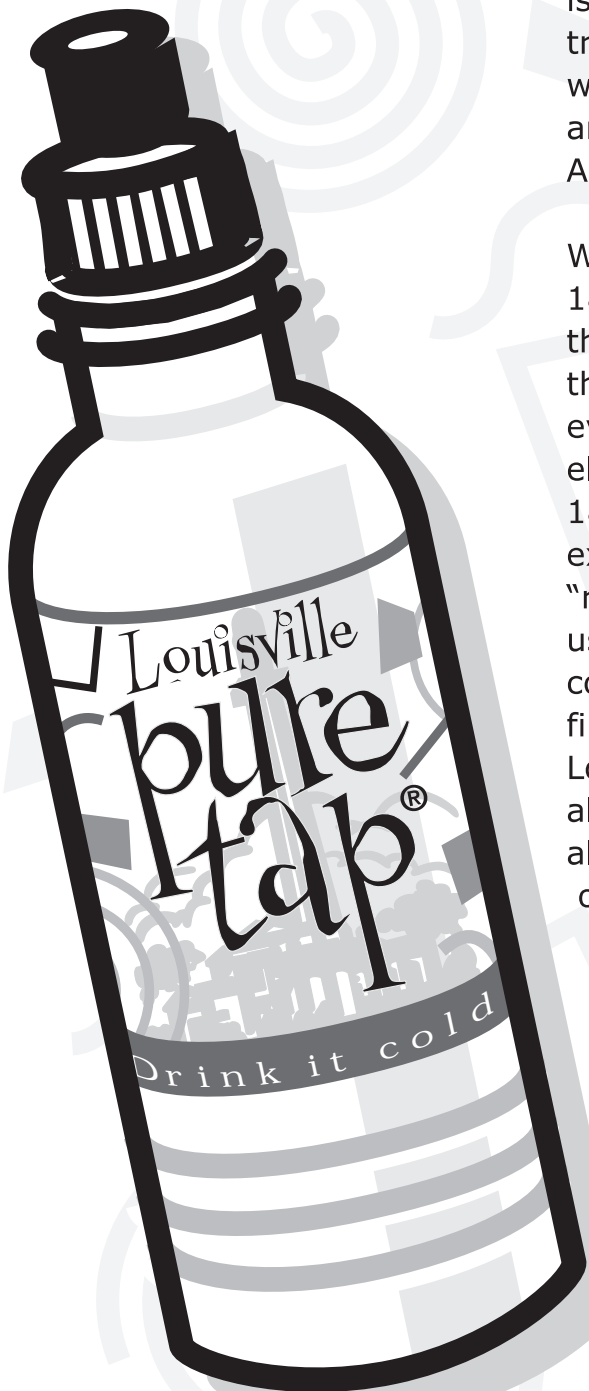
# THE FABULOUS FILTER

## The Importance of a Filter

A **filter** is something that strains out particles. Filtration is one of the most important steps in the water treatment process. Louisville Water Company pioneered work on the filter with engineers George Warren Fuller and Charles Hermany in the late 1800's. Cities across America copied what they learned.

When Louisville Water Company first pumped water in 1860 customers became accustomed to drinking water that still had tiny particles of sand and mud. In addition, the **typhoid** rate in Louisville was well over 100 deaths every year. Engineers knew they needed to do something else to clean the **turbid** or cloudy Ohio River water. In 1895 George Warren Fuller and Charles Hermany began experimenting with filters. They created what's called a "rapid sand filter", the type Louisville Water Company uses today. The filter is made of **anthracite coal** (a fine coal), sand and gravel. The engineers discovered the filter removed all the sand and mud that had discolored Louisville's drinking water since the beginning. The filter also removed 99% of the bacteria in the water. Filtration along with the use of chlorine, also dropped the statistics of typhoid fever to 28 deaths a year by 1916; today, typhoid fever is all but unknown.

Louisville opened its filtration plant in Crescent Hill in 1908.



## How Does the Filter Work?

By the time the water reaches the filter beds it has passed through the reservoir, the coagulation basins (where ferric chloride was added to bring particles together as clumps) and had chlorine added. The filter removes any remaining particles and bacteria as water passes through it.

The filter beds at Louisville Water Company are nine feet deep. Each filter contains layers of the anthracite coal, sand and different size rocks. (The bigger rocks are at the bottom.)

Each filter cleans about six million gallons of water a day. We clean the filters every four to five days by back-washing water through them. (This water is taken to a lagoon at the B.E. Payne Plant.)



# WATER WORDS

## **Anthracite coal:**

a fine coal found in eastern Kentucky that's part of the filter Louisville Water Company uses.

## **Filter:**

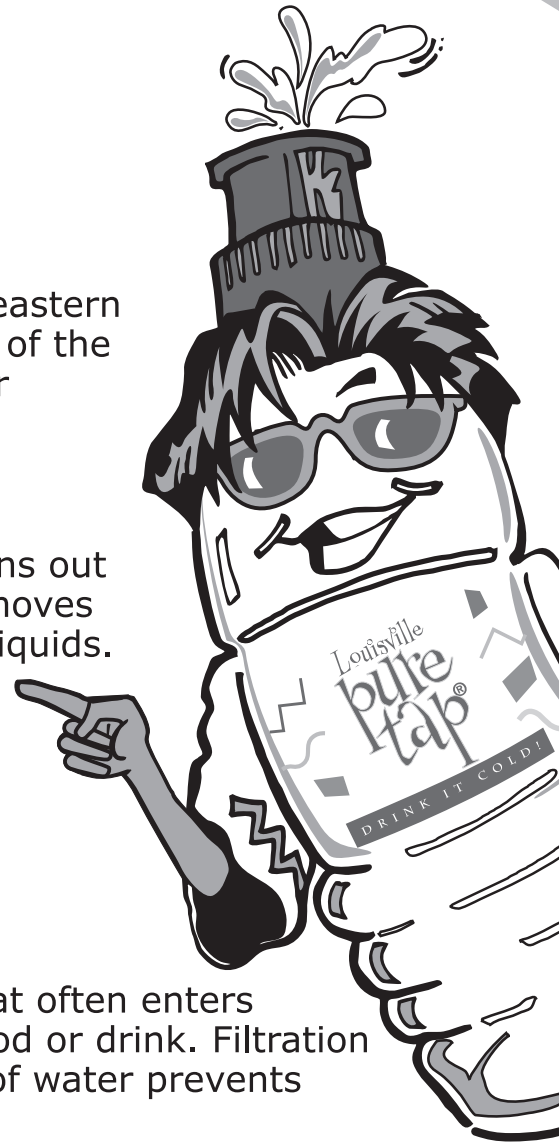
something that strains out particles. A filter removes solid particles from liquids.

## **Turbid:**

cloudy

## **Typhoid:**

a serious disease that often enters the body through food or drink. Filtration and/or chlorination of water prevents waterborne typhoid.



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# Activity #1: Where's the Filter?

## Objective:

Students will understand where filters are used.

**This activity is a good way to introduce the filter concept to students**

## Time:

20 minutes

## You'll need:

- Copies of "Where's the Filter?" for each student.

## Here's what to do...

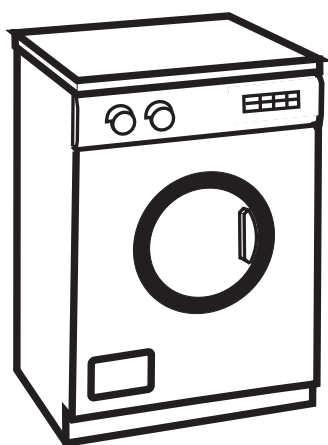
1. Give each student a copy of "Where's the Filter?"
2. Have them brainstorm the definition of a filter.
3. Instruct them to circle all the items on the page that have a filter. They should be prepared to say why or why not the item uses a filter.

**Teacher note: All of the items on the page have a filter.**

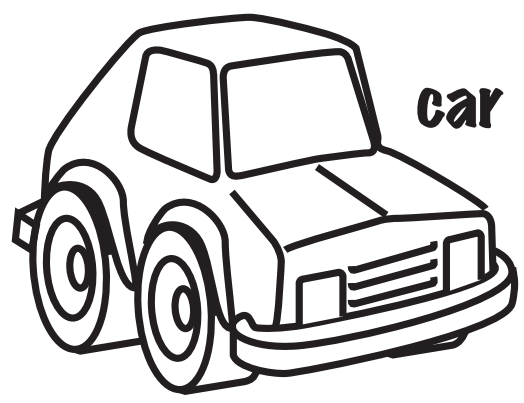


# Where's the Filter?

You can find filters everywhere. Circle the items that use a filter!



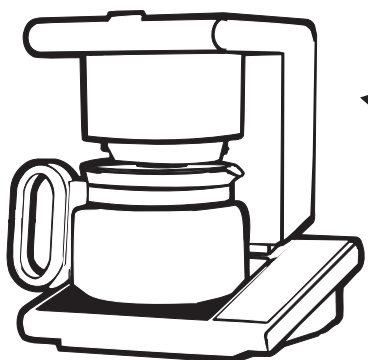
clothes  
dryer



car



vacuum  
cleaner

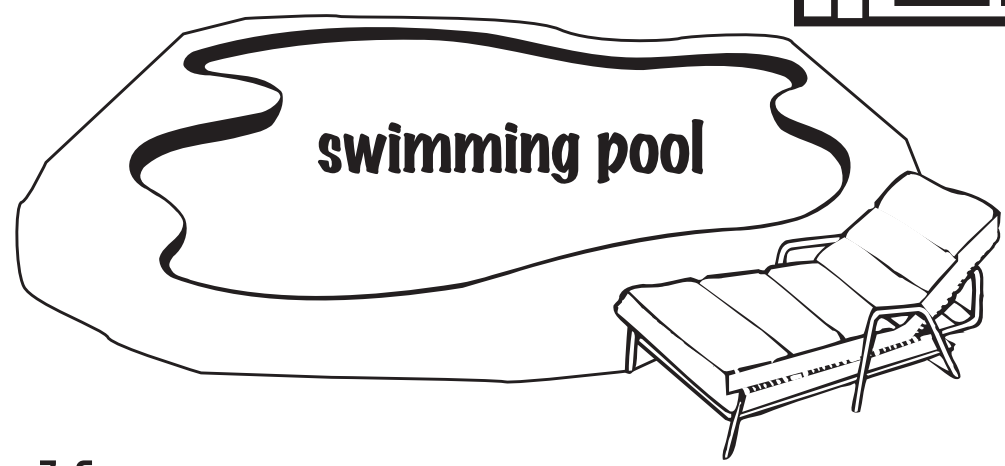
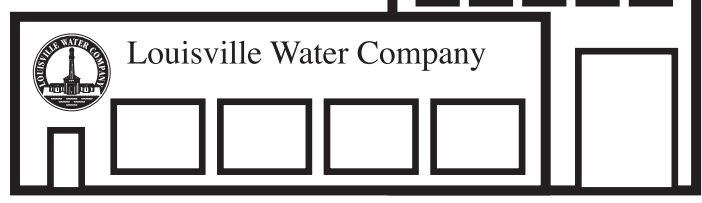


coffee  
maker

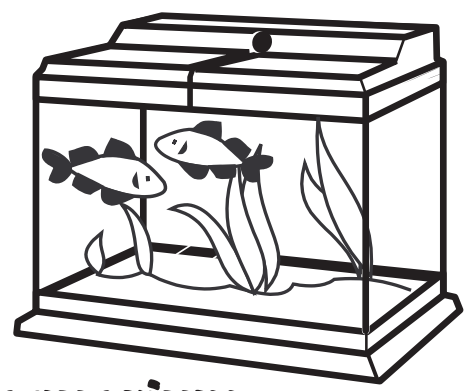


tea bag

Water  
Treatment  
Plant



swimming pool



aquarium

# Activity #2: The Best Filter

**Objective:** Students will learn what items work as a filter to remove mud from water.

**Time:** 45 minutes.

**You'll need:**

- Sand
- Cotton balls
- Sponges
- Paper towels
- Clear cups
- Measuring cup
- Potting soil
- Two-liter bottles cut in half (one for each group)
- Small and large rocks (rinse them with water)
- Newspaper
- Net
- Gauze
- Coffee filters
- Water
- Pitcher
- Rubberbands



**Here's what to do...**

1. Put students in groups and explain that each group will construct a filter out of the two-liter bottle. The goal is to see which filter design can remove the most mud from the water.
2. Go through the list of choices. Each filter can have three different items. Give each group a copy of the activity sheet and have them come up with a design. Put each design on the board. Talk about the items the students did and did not choose.
3. Build the filters. Layer the three items inside. *(If a group chooses sand or pebbles, you can attach a small piece of paper towel to the outside to keep the material inside.)*
4. Test each filter. Use your eyes to watch the water coming out – is there mud, does it look clean? Look at the yield – how much water does the filter produce. To make it a "fair experiment", pour one-cup of water through each filter. Catch the water in a clear glass..
5. Talk about the results. Which items worked well? Take the designs apart – what removed the mud? A good filter design is one that does not have mud at the bottom where the water comes out. The filter should remove the mud in the top and middle layers. If you did the experiment again, what would you not use?

**Note:** All of the items above can work as a filter in some way. Louisville Water Company's filters are made of sand and gravel with a layer of coal at the top. Students often comment about the "speed" the water moves through the filter. Fast doesn't necessarily mean clean!



**Think  
about  
it!**

Hopefully one group will construct a filter that resembles the ones used at Louisville Water Company. If not, you may want to do this as a follow-up. Compare the filtered water in each cup to the muddy water. How did the filter treatment change the appearance of the water?





# The Question. What do I want to know?

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## My Filter Design

1. Draw a picture of your filter. Label the items inside.

Why I chose the items for the filter design.

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# Activity #2: The Best Filter.

You observe using your five senses. You infer when you tell about what you observe.

<b>OBSERVE</b> What did you see when the water was poured into the filter?	<b>INFER</b> What can you infer from your observations?

What questions do you still have?

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What would you do different if you did this experiment again?

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# Open Response Question

## How Clean Is It?

**Our class did an experiment to see what items could filter dirt from water. We built different filter designs then collected data.**

1. List two items that worked well as a filter.

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List two items that did not work as a filter.

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2. For all the items you list explain why they did or did not work.

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# Open Response Question

## How Clean Is It?

**Our class did an experiment to see what items could filter dirt from water. We constructed different filter designs then collected data.**

1. List two items that worked well as a filter.  
List two items that did not work as a filter.
2. For all the items you list explain why they did or did not work.

## SCORING GUIDE

- 4**—Student correctly identifies two items that did and did not work as filters. Student explains the reasoning behind each. Student has a good understanding of why something does or does not work as a filter.
- 3**—Student correctly identifies two items that did and did not work as filters. Student has a general understanding of why they did or did not work.
- 2**—Student correctly identifies one item that did and did not work **OR** student only answers part of #1. Student has a limited understanding of items that did or did not work.
- 1**—Student answers #1 but does not answer #2.
- 0**—No response.



# Open Response Question

**A filter is something that separates particles. You've learned there are different kinds of filters.**

**A. Describe two types of filters.**

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**B. Explain what the filter does in each.**

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# Open Response Question

**A filter is something that separates particles.  
You've learned there are different kinds of filters.**

- A. Describe two types of filters.**  
**B. Explain what the filter does in each.**

## SCORING GUIDE

- 4**—Student correctly identifies two types of filters and shows an in-depth understanding of the function of each.
- 3**—Student selects two types of filters and shows a general understanding of the function of each. Response may lack details or contain minor errors. Or, student selects one filter and shows a general understanding of the function.
- 2**—Student selects two types of filters and shows a limited understanding of the functions. The response may contain errors or omissions. Or, student selects one filter and shows a general understanding of the function.
- 1**—Student selects one type of filter. Attempts to respond to the question, but is incorrect.
- 0**—No attempt or relevant answer.

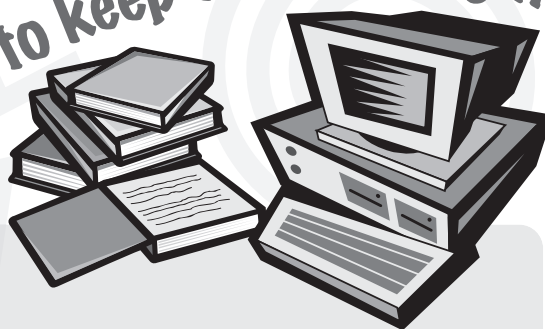
### ***Look for:***

- Understanding of a filter's purpose—something that strains out particles.
- Student recognizes filters are found in many items.
- In regards to water treatment, filters help make drinking water clean.



# THE FABULOUS FILTER

Check out these opportunities to keep the learning flowing!



## Web sites:

[www.epa.gov/seahome/groundwater/src/geo2.htm](http://www.epa.gov/seahome/groundwater/src/geo2.htm) *Learn about the role of filters in ground water.*

## Louisville Water Company Opportunities:

Call the Public Information Department at 569-3600 to schedule a classroom presentation on water treatment.

[www.tappersfunzone.com](http://www.tappersfunzone.com) *Click on "Teacher Tools" for a supplement to this section.*

**Extra, Extra!!!**